

National Aeronautics and
Space Administration

Goddard Space Flight Center

Mission Services Program, Code 450
Greenbelt, Maryland 20771
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451-PSLA-GLAST

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GLAST Project Service Level Agreement	FY04 Operating Year Agreement <input type="checkbox"/> Final Agreement <input checked="" type="checkbox"/> Preliminary (Pending Budget Approval)
Mission Type <input checked="" type="checkbox"/> NASA <input type="checkbox"/> Reimbursable	Future Year Planning for <input type="checkbox"/> FY05– FY09
NASA/Space Communications and Data Systems (SCDS) Requirements and Funding Agreement Approved by:	
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PSLA HISTORY LOG

Issue	Effective Date	Expiration Date	Description of Changes
CCR 451/xxx			
CCR 451/xxx			

PURPOSE

This Project Service Level Agreement (PSLA) describes space communications and data system requirements within the scope of services provided by the NASA's Space Communications and Data Systems (SCDS), whether actually performed by NASA, the customer project, or other sources. The primary purpose of a PSLA is to:

- Document the operations approach selected based on the lowest life-cycle cost to NASA or other factors;
- Define the requirements for services to be provided through other mechanisms; and
- Identify any development required to augment standard services.

The requirements and costs in this PSLA will be reviewed, updated, and approved/signed annually.

This document is under configuration management of the GSFC Customer Commitment Office, Code 451, Configuration Control Board (CCB).

Proposed changes to this document shall be submitted to the Code 451 CCB along with supportive material justifying the proposed change.

Changes to this document will be made by Documentation Change Notice (DCN) or complete revision.

Comments or questions concerning this document, and proposed changes, may be addressed to:

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ACRONYMS

<u>Term</u>	<u>Definition</u>
AWCS	Agency Wide (NASA) Coding Structure
DSN	Deep Space Network
FDF	Flight Dynamics Facility (GSFC)
FY	Fiscal Year
GSFC	Goddard Space Flight Center
GN	Ground Network
IDIQ	Indefinite Delivery/Indefinite Quantity
JPL	Jet Propulsion Laboratory
LV	Launch Vehicle
MCE	Mission Commitment Engineer
MCM	Mission Commitment Manager
NASA	National Aeronautics and Space Administration
NISN	NASA Integrated Services Network
NR	Not Required
PCD	Project Commitment Document
POC	Point of Contact
PSLA	Project Service Level Agreement
RLV	Re-usable Launch Vehicle
SCDS	Space Communications and Data Systems
SN	Space Network
UPN	Unique Project Number
WATR	Western Aeronautical Test Range

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SECTION A. CUSTOMER INFORMATION

Project/Mission Full Name: Gamma-Ray Large Area Space Telescope

Acronym or Short Title: GLAST

Points of Contact

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Category/Sponsor:

NASA

- ☐ Code M
- ☐ Code R
- ☒ Code S
- ☐ Code U
- ☐ Code Y
- ☐ Other
- ☐ Cooperative with

Reimbursable

Non-NASA U. S. Government

☐

U.S. Commercial Space Launch Act

☐

Non-NASA Foreign

☐

Other

☐

Mission Objectives:

The Gamma-Ray Large Area Space Telescope (GLAST) mission is NASA's next major mission dedicated to observations of high energy gamma rays over the entire celestial sphere. GLAST will identify and study nature's high-energy particle accelerators, use these sources to probe important physical parameters of the galaxy and the universe, and use high-energy gamma-rays to search for fundamentally new phenomena.

**Launch/Flight
Information:**

- | | | |
|---|-----------------------------------|--------------------------------------|
| <input type="checkbox"/> Space Shuttle LV | <input type="checkbox"/> Aircraft | <input type="checkbox"/> RLV |
| <input checked="" type="checkbox"/> Expendable LV | <input type="checkbox"/> Balloon | <input type="checkbox"/> Other _____ |

Specify: Vehicle Delta II Heavy

Upper Stage _____

Launch Vehicle Customer/Sponsor:

Launch Site: CCAS Eastern Range

Operations Site:

Trajectory Regime Description:

Launch/Flight Date(s): February 2007

Orbit/Flight Path Data:

Check all that apply:

- | | | |
|---|---|--|
| <input type="checkbox"/> Aeroflight | <input type="checkbox"/> High-Earth Orbit | <input type="checkbox"/> Suborbital |
| <input type="checkbox"/> Deep Space | <input checked="" type="checkbox"/> Low-Earth Orbit | <input type="checkbox"/> Selenocentric |
| <input type="checkbox"/> Heliocentric | <input type="checkbox"/> Formation-Flyer | |
| <input type="checkbox"/> LaGrange Point | | |
| <input type="checkbox"/> Other | | |

Orbital Parameters:

Apogee: 565km **Perigee** 565km **Inclination:** 28.5 degrees

Other Trajectory Information:

GPS Satellite System

Key Mission Events and Dates:

**Launch and/or Mission Critical
Support Items:**

Launch Support: February 2007

Approved Start Date: 1/26/1999

Implementation Phase Start Date: 7/2001

Funding Approved: ☒ Yes ☐ No

Present Phase of Development: _____ [Formulation, Implementation, or Operations]

Requirements Maturity Assessment: ☐ >80% ☒ >50% ☐ <50%

Funded Support from 2/2007 to 2/2012

Potential Support Extension until 2/2017

Frequency Authorization Valid from (mo/yr): _____ **to (mo/yr):** _____

Other: Program Element Duration: 10 years with a 5 year minimum

SECTION B. CUSTOMER REQUIREMENTS AND STANDARD SERVICES

B.1 NETWORKS/DATA SERVICES

B.1.1 Ground Network Services

The Ground Network will support the GLAST Project for pre-launch test, launch, early orbit and long term contingency operations. The GLAST project is considering Wallops, MILA, and the USN as candidates for this support.

B.1.1.1 Customer Requirements

Support is required by the Ground Network for RF compatibility testing, pre-launch testing; launch support and the first 60 days of support. Contingency/backup long-term mission support with anomaly support is required as needed. Supporting ground stations must have the capability to store telemetry data for up to 7 days for all data types. Science data (PB) latency is 12 hours maximum at the ground station site from time of ground station receipt to receipt by the MOC. Ground stations must have the capability to allow the MOC to remotely monitor the status of the ground station.

B.1.1.2 Services Provided

Required services are documented in Table B-1. GN Mission Phase Requirements, and Table B-2. GN Standard Link Requirements

(1) GN Mission Phase Requirements

Table B-1. GN Mission Phase Requirements

Phase	Period (e.g., L+30 days)	No. of Contacts Required (Min./Max.) (per day)	Contact Duration Required (Min./Max.) (minutes)	Total Contact Time (minutes per day)	Min./Max. Interval between Contacts (minutes)	High Latitude (%)	Low Latitude (%)	Launch, Sub-Orbital, Human
Testing	L-32 months	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Launch and Early Orbit	L + 72 hours (TBD)	4/day	6-7 mins /contact					
Ops Checkout & Verification	60 days	4/day	6-7 mins /contact					
On-Orbit								
Contingency	L + 5-10 years	1/month	6-7 mins /contact.					
Special								

(2) GN Mission Phase Special Requirements and Equipment

Not Applicable

(3) GN Standard Link Requirements

Not Applicable

Table B-2. GN Standard Link Requirements

Band	Frequency (MHz)	Subcarrier (MHz)	Data Rate (Kbps)	EIRP (dbW)	Modulation	Coding	Input Format	Delivery Format	Tracking Config.
S-band									
CMD	TBS		2						N/A
TLM	TBS		2500		QPSK			NRZ-M	N/A
I	TBS	TBS	TBS	TBS	TBS	TBS	TBS	TBS	N/A
Q	TBS	TBS	TBS	TBS	TBS	TBS	TBS	TBS	N/A
X-band									
CMD									
TLM									
I									
Q									
L-band									
CMD									
TLM									
I									
Q									

(4) GN Telecommunications and Tracking Special Requirements and Equipment

Not Applicable

(5) Spacecraft Recorder Information - TBD

(6) Spacecraft Recorder Special Requirements - TBD

B.1.2 Space Network Services

The GLAST Project will require GCN notification of burst alert messages within 7 seconds of observation by the observatory. In addition, the GLAST Project will need to notify the observatory of burst triggers detected by other sources within 30 minutes. The Space Network (SN) will be utilized for these purposes, as well as for spacecraft clock correlation as a backup. Ranging will be performed during Launch to Launch + 1 week for OD.

B.1.2.1 Customer Requirements

GLAST burst alerts will be transmitted almost instantaneously through the Tracking and Data Relay Satellite System (TDRSS) Demand Access System (DAS) link. This will be accomplished by the WSC for full time Multiple Access Return (MAR) service and Single Access Return (SAR) service. Bursts detected by other sources will be evaluated and sent by the TDRSS MA forward (MAF) service to the GLAST observatory on a short turn-around basis. Regular bulk science data and housekeeping will be transmitted to a ground station then to the MOC for level 0 processing prior to delivery to the GSSC at GSFC. Quick-look results are posted to the GLAST website shortly after data is received at the MOC.

The TDRS DAS return service will be required 24 hours per day/7 days per week to relay the observation of burst alert messages to the GRB community and MOC flight and science operations personnel. The GLAST Project will utilize the MAF on-orbit, near real-time forward service to notify the GLAST observatory of any Target of Opportunity (ToO) detected by other sources. In addition to the DAS return and quick response forward MA services, the TDRS MA forward will be utilized for contingency commanding. Coherent forward/return MA events will also be scheduled for spacecraft clock correlation as backup operations.

For planning purposes and in addition to the DAS MAR services, individual MA forward/return on-orbit services are currently estimated as follows: MAF and MAR events of 6-7 minutes each, four times per day.

B.1.2.2 SN Data Formatting and Interface

B.1.2.3 Services Provided

a. SN Return Link Services

SN will provide S-band Multiple Access Return (MAR) and Single Access Return (SAR) on-orbit, near real-time return services.

SN will provide Ku-band SAR on-orbit, near real-time return services.

Duration: Pre-launch testing and Launch to EOM.

b. SN Commanding

SN will provide S-band Multiple Access Forward (MAF) and Single Access Forward (SAF) on-orbit, near real-time forward services.

Duration: Pre-launch testing and Launch to EOM.

c. SN Tracking

SN will provide DOWD data to the FDF as necessary.

The GLAST MOC will provide Improved Inter-Range Vector (IIRV) data acquisition.

Duration: Pre-launch testing and Launch to EOM.

d. SN Scheduling

GLAST will utilize the SN Webpage Scheduling System Interface (SWSI) to schedule SN services.

Duration: Pre-launch testing and Launch to EOM.

e. SN Real-time Control and Performance Data Monitoring

GLAST will utilize the SWSI for real time control and data monitoring services.

Duration: Pre-launch testing and Launch to EOM.

f. SN Testing

SN will provide pre-launch testing activities as required.

Duration: L – 30 months to Launch.

g. Summary Data

[Note: This summary data represents preliminary assumptions of mission requirements. Each mission phase may require multiple services. Final service selection will be based on customer requirements, compatibility, and operational availability.]

(1) SN Mission Phase Requirements

Table B-3. SN Mission Phase Requirements

Phase	Period (e.g., L+30 days)	No. of Contacts Required (Min./Max.) (per day)	Contact Duration Required (Min./Max.) (minutes)	Total Contact Time (minutes)	Min./Max. Interval between Contacts (minutes)	Service Requested
Testing	L-32 months	TBD	TBD	TBD	TBD	TBD
Launch and Early Orbit	L + 72 hours (TBD)	24 hrs. continuous	TBD	TBD	N/A	S-band DAS (continuous) S-band MAR/MAF as required S-band SA as required Ku-band SAR as required
Ops Checkout & Verification	60 days	24 hrs. continuous	TBD	TBD	TBD	S-band DAS (continuous) S-band MAR/MAF as required S-band SA as required Ku-band SAR as required
On-Orbit	L + 5-10 years	24 hrs. continuous 4 MA events per day	6-7 mins	6-7 mins		S-band DAS (continuous) S-band MAR/MAF S-band SA as required Ku-band SAR as required
Contingency	TBD	TBD	TBD	TBD	TBD	TBD
Special	TBD	TBD	TBD	TBD	TBD	TBD

(2) SN Mission Phase Special Requirements and Equipment

Not Applicable

(3) SN Standard Link Requirements

Table B-4. Space Network Standard Link Requirements

SN Service	Frequency (MHz)	Data Rate (Kbps)		EIRP (dbW)	Modulation	Coding	Input Format	Delivery Format	Tracking Config.
		Real-time (Kbps)	Playback (Kbps)						
K-band Single Access									
CMD	N/A								
TLM	15003.4	100	40,000	TBS	QPSK	TBS	TBS	TBS	TBS
I	TBS	TBS	TBS	TBS	TBS	TBS	TBS	TBS	TBS
Q	TBS	TBS	TBS	TBS	TBS	TBS	TBS	TBS	TBS
S-band Single Access									
CMD	TBS	4.0	N/A	TBS	TBS	TBS	TBS	TBS	TBS
TLM	2287.5	1.0, 2.0, 4.0, 8.0	N/A	TBS	QPSK	TBS	TBS	TBS	TBS
I	TBS	TBS	N/A	TBS	TBS	TBS	TBS	TBS	TBS
Q	TBS	TBS	N/A	TBS	TBS	TBS	TBS	TBS	TBS
Multiple Access (DAS and MAR/MAR)									
CMD	2106.40625	0.250	N/A	TBS	TBS	TBS	TBS	TBS	TBS
TLM	2287.5	1.0 (See note)	N/A	TBS	TBS	TBS	TBS	TBS	TBS
I	TBS	TBS	N/A	TBS	TBS	TBS	TBS	TBS	TBS
Q	TBS	TBS	N/A	TBS	TBS	TBS	TBS	TBS	TBS
S-band Multiple Access									
CMD									
TLM									
I									
Q									

Note: SN will support MAR telemetry data rates of 2kbps on a best effort basis due to negative link margins.

(4) SN Telecommunications and Tracking Special Requirements and Equipment

Not Applicable

(5) Spacecraft Recorder Information - TBD

(6) Spacecraft Recorder Special Requirements - TBD

B.1.3 Customer Integration and Test

a. Customer Requirements

Support is required from the Compatibility Test Van (CTV) for SN, DAS and WDISC compatibility testing. Standard RF testing will be conducted to simulate TDRSS links and to perform RF relay testing through TDRSS. The CTV will be expected to make at least 2 trips to the spacecraft manufacturer's factory in Phoenix, Arizona to support I&T and RF testing.

Duration: estimated 7 days per trip, 1 trip in FY05 and 1 trip in FY06.

Support is required from the Simulations Operations Center (SOC) for Space Network support.

Duration: FY05 through FY06

Standard data flow and end-to-end tests will also be performed to verify command and telemetry data flow between the SN WDISC and the GLAST MOC.

b. Services Provided

TBD

B.2 DEEP SPACE NETWORK (DSN) SERVICES

B.2.1 Customer Requirements

Not Applicable

B.2.2 Services Provided

Not Applicable

FLIGHT DYNAMICS SERVICES TO THE GN AND SN

B.2.3 Customer Requirements

The Flight Dynamics Facility will provide orbit determination support to the MOC for launch and early orbit phases of the mission. The FDF will also provide post launch orbit solutions the GLAST MOC within 1 hour after launch. The FDF will also provide contingency support as needed.

B.2.4 Services Provided

FDF shall distribute the post launch orbit solution for distribution to the MOC within 1 hour after GLAST launch using real-time inertial guidance (RIFCA) data from KSC/Boeing. Duration: L to L + 1 hour.

For initial GPS checkout and as contingency in case of GPS receiver failure, the FDF will used Differenced One-Way Doppler (DOWD) for obtaining orbit determination. The accuracy of the orbit determination must be within +/- 1 km. Duration: L to end of mission (EOM)

The FDF will utilize the NORAD TLE sets for orbit determination for contingency. FDF will provide Orbit Determination (OD). The accuracy of the orbit data products provided to the MOC must be sufficient for acquisition only. Duration: L to L + 192 hours.

B.3 RANGE SERVICES

B.3.1 Wallops Flight Facility (WFF) Range Services

B.3.1.1 Customer Requirements

Not Applicable

B.3.1.2 Services Provided

Not Applicable

B.3.2 Western Aeronautical Test Range (WATR) Services

B.3.2.1 Customer Requirements

Not Applicable

B.3.2.2 Services Provided

Not Applicable

B.4 NASA INTEGRATED SERVICES NETWORK (NISN) SERVICES (CUSTOMER-FUNDED SERVICES ONLY)

The GLAST Project will establish the MOC in Building 14, Second floor with connections to the GSFC CNE and IONet OPEN networks.

The GLAST Project will establish the MOC in Building 14, Second floor with connections to the GSFC CNE and IONet OPEN networks. See Figure #1 (TBS).

1. Routed Data Connections

WAN data support is required between the following locations with the bandwidths allocated for each link:

a.) WSC to MOC - IONet OPEN - 256 kbits/sec full duplex infrastructure WAN connection (used for all telemetry data except Ku-band playback files) *TCP/IP* Mission Critical
Duration: L - 32 months to EOM

b.) WSC to MOC - Internet to CNE - 1.544 Mbits/sec full duplex (used for playback file transmission) *FTP* Premium Service
Duration: L - 32 months to EOM

c.) MOC to Spectrum Astro manufacturing facility (Phoenix, Arizona) – Leased commercial line connecting to IONet OPEN – 512 kbits/sec full duplex multiplexed (used for I&T support) *TCP/IP, FTP*.
SPECIAL NOTE: IONet OPEN termination equipment to be installed tested and maintained on site at Spectrum Astro's facility. Mission Critical
Duration: L - 32 months to L + 90 days

d.) MOC to KSC Astro Tech and SLC-17B – IONet OPEN - 512 kbits/second full duplex (used for pre-launch support, pad functional tests and telemetry backfeed from MOC) *TCP/IP, FTP* Mission Critical
Duration: L - 3 months to L + 10 days

e.) MOC to Ground Stations – IONet OPEN – 512 kbits/sec full duplex infrastructure WAN connection (if available) *TCP/IP, FTP* Mission Critical

2. Voice Connections

Voice support is required between the following locations:

a.) MOC to FDF, WSC – SN COORD SCAMA infrastructure connection using Talk, Listen and Monitor using 4 wire connectivity, tip ring sleeve
Duration: L - 32 months to EOM

b.) MOC to Spectrum Astro – SN COORD, GLAST OPS1, GLAST OPS2 SCAMA connection using Talk, Listen and Monitor using 4 wire connectivity, tip ring sleeve on multiplexed leased line from MOC to Spectrum Astro manufacturing facility.
Duration: L - 32 months to EOM

c.) MOC, FDF to KSC - SN COORD, GLAST OPS1, GLAST OPS2 SCAMA connection using Talk, Listen and Monitor using 4 wire connectivity, tip ring sleeve infrastructure connection from MOC to Astro Tech processing facility at KSC.
Duration: L - 3 months to L + 10 days.

SECTION C. UNIQUE CUSTOMER REQUIREMENTS FOR NON-STANDARD SERVICES

Not Applicable

C.1 NON-STANDARD SERVICES (CONTRACTOR-PROVIDED)

Not Applicable

C.2 PROJECT COMMITMENT DOCUMENT (PCD) REQUIREMENTS

Not Applicable

C.3 NON-NASA SERVICES

Not Applicable

C.4 SUPPORTED BY TASK ORDER

Not Applicable

SECTION D. SERVICE AND SCHEDULE SUMMARY

D.1 FUNDING RESPONSIBILITY

For NASA projects, data services will be funded to the extent that the requirements are covered in the approved Operating Plan. If the total requirements of a sponsoring Enterprise exceed the capacity supported by the operating plan, the customer project or Enterprise will be required to fund the cost of acquiring additional capacity.

Requirements may be changed to reflect the approved budget, cost trades, and utilization trades prior to final signature.

D.2 ESTIMATED SERVICES FOR FUTURE YEARS

For planning purposes only, Table D-1 estimates the projection for operations service requirements in future years.

The GLAST Project is not scheduled for launch until February 2007 and the NENS contract is not scheduled to begin until January 2004. The GLAST mission was not included in the current version of the FY04 Operating Plan. Estimated services for future years will be addressed in the next version of the Operating Plan.

NASA projects only: Funding for services will be limited by the approved Operating Plan budget.

Table D-1. Estimated Services for FY07 – FY09

Service Title	Unit Description	Current Year	Service Projections				
			FY05	FY06	FY07	FY08	FY09
Ground Network Services	Passes				250	12	12
Space Network DAS Services	Minutes				86,400	86,400	86,400
Space Network MA Services	Minutes				10,220	10,220	10,220
Flight Dynamics Facility	Annual Cost				1	1	1
NISN Services							

SECTION E. PROJECTED DOCUMENTATION SET

- ☐ Memorandum of Agreement/Memorandum of Understanding (MOA/MOU)
- ☐ Mission/Project Management Plan [prior to 'Implementation' Phase]
- ☐ Radio Frequency Interface Control Document (RFICD) [1 year prior to launch]
- ☐ Interface Control Document (ICD) [1 year prior to launch, if necessary]
- ☐ Detailed Mission/Network Requirements (DMR) [6 months prior to launch]
(Refer to *Detailed Requirements Generation Process*, 450-PG-1310.1.2E)
- ☐ Mission Operations Support Plan (MOSP) [6 months prior to launch]
- ☐ Operations Interface Procedures (OIP) [6 months prior to launch]
- ☐ Network Operations Support Plan (NOSP) [6 months prior to launch]
- ☐ Operations Readiness Review (ORR) [1-2 months prior to launch, or two weeks prior to MRR]
- ☐ JPL Network Operations Plan (NOP) [6 months prior to launch, if applicable]
- ☐ Other _____

Reference Documents